SHEET TRANSPORTING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

5   The invention relates to a sheet transporting apparatus, and particularly to the correction of the position of a sheet in the cross direction thereof perpendicular to a sheet transport direction and the correction of the skew feed posture of the sheet
10   relative to the sheet transport direction.

Description of the Related Art

          In an image forming apparatus such as a copying machine, or an image reading apparatus, a registration (skew feed correction) device for the
15   posture correction and alignment of a sheet being transported is provided immediately before the image forming portion or the image reading portion thereof. As such a registration device, there is, for example, an active registration system for correcting the skew
20   feed of a sheet while transporting the sheet. This system is such that two original detecting sensors are disposed in a sheet transport path in the cross direction (hereinafter referred to as the main scan direction) of the sheet perpendicular to a sheet
25   transport direction, and detect the skew of the leading edge of the sheet on the basis of a signal produced by the leading edge of the sheet crossing

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the respective sensors, and also the sheet
transporting speed of skew feed correction rollers
(hereinafter referred to as the registration rollers)
disposed in the main scan direction and drivable
5   independently of each other is controlled to thereby
correct the skew feed of the sheet.

According to this system, skew feed correction
can be effected while the sheet is transported
without being once stopped and therefore, the
10   throughput of the sheet is not reduced. Fig. 13 of
the accompanying drawings is a typical view
illustrating a method of correcting the skew feed of
a sheet transported by the active registration system.

As the above-described conventional skew feed
15   correction control method, there is an acceleration
and deceleration control method or the like as shown
in Fig. 13 wherein a transport roller 14 on one side
preceding by skew feed is deceleratedly driven (the
arrow D in Fig. 13) and at the same time, the
20   accelerated drive of a transporting roller 13 (the
arrow A in Fig. 13) on the other side delayed is
effected.

On the other hand, the skew feed direction, the
detected skew feed amount (Nb), etc. of an original
25   transported by rollers 13 and 14 are measured by
original detecting sensors 15 and 16. As drive
sources for rotatively driving the rollers 13 and 14,

use is usually made of pulse motors 11 and 12, and
the aforementioned detected skew feed amount Nb is
measured by counting the time from after one of the
original detecting sensors 15 and 16 has detected the
original until the other sensor detects the original,
by counting clocks driving the pulse motors 11 and 12.

Further, the original detecting sensors 15 and
16 are disposed at distances equal from the center of
the main scan direction to the right and left and
therefore, there is the characteristic that when skew
feed control is effected in conformity with the
detected skew feed amount Nb calculated from the
detection information of these detecting sensors 15
and 16, the transport of the original in the central
portion of the main scan direction of the original
does not differ from the ordinary transport thereof,
in the case of the acceleration and deceleration
control method.

However, an improvement in the sheet
transporting speed has sometimes caused, in addition
to the skew feed of the sheet, the deviation of the
sheet position in the main scan direction.

By the conventional active registration system,
it has been impossible to detect the deviation of the
sheet position in the main scan direction and
therefore, to correct the deviation of the sheet
position.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above-noted problem and an object thereof is to provide a sheet transporting apparatus which can

5 efficiently effect the correction of the positional deviation of a sheet in the main scan direction and the correction of the skew feed of the sheet.

(1) In order to achieve the above object, a sheet transporting apparatus according to the present

10 invention has a pair of sheet transporting members having rotary shafts on the same axis in a direction perpendicular to the transport direction of a sheet and rotatively driven independently of each other to thereby transport the sheet, detecting means provided

15 along a cross direction perpendicular to the sheet transport direction for detecting the transported state of the sheet transported by the sheet transporting members, and control means for drive-controlling the pair of sheet transporting members on

20 the basis of the detection information of the detecting means, and effecting the correction of a sheet position in the cross direction and the correction of the skew feed posture of the sheet relative to the transport direction.

25 (2) In the above item (1), the control means may preferably give a transporting speed difference

between the pair of transporting members.

(3) In the above item (1), the detecting means may preferably be a line sensor disposed in parallelism to the cross direction and the size of a detectable area in the cross direction by the line sensor may preferably be larger than the size of at least an area through which the sheet passes when transported in the cross direction.

(4) In the above item (1), the detecting means may preferably be disposed upstream of the pair of transporting members with respect to the sheet transport direction.

(5) In the above item (1), the detecting means may preferably be disposed downstream of the pair of transporting members with respect to the sheet transport direction.

(6) In the above item (1), the control means may preferably effect deviation correction control in the cross direction and skew feed direction of the sheet caused by the pair of transporting members in parallel with each other.

(7) In the above item (1), the sheet transporting apparatus may preferably have calculating means for calculating the movement direction and the movement amount of the sheet in the cross direction, and the skew feed direction and the skew feed amount of the sheet, relative to a normal

transport position, on the basis of the detection information of the detecting means.

(8) In the above item (7), the calculating means may preferably calculate the skew feed direction and the skew feed amount after the deviation correction control in the cross direction of the sheet to thereby calculate a total skew feed direction and a total skew feed amount, and the control means may preferably effect the deviation correction control in the skew feed direction of the sheet on the basis of the total skew feed direction and the total skew feed amount.

Other objects and features of the present invention will become apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view showing the construction of the essential portions of a first embodiment of the present invention.

Fig. 2 is a block diagram showing the control construction of the sheet transporting apparatus of Fig. 1.

Figs. 3A and 3B are typical views illustrating a main scan deviation detecting method and a skew feed detecting method in the sheet transporting apparatus of Fig. 1.

Fig. 4 is a flow chart illustrating the control procedure of effecting main scan deviation correction and skew feed correction in the first embodiment of the present invention.

5   Fig. 5 is a schematic view illustrating the construction of the essential portions of a second embodiment of the present invention.

Fig. 6 is a block diagram illustrating the control construction of the second embodiment of the

10 present invention.

Figs. 7A and 7B are typical views illustrating a main scan deviation detecting method and a skew feed detecting method in the second embodiment of the present invention.

15 Fig. 8 is a flow chart illustrating the control procedure of effecting main scan deviation correction and skew feed correction in the second embodiment of the present invention.

Fig. 9 is a schematic view illustrating the

20 construction of the essential portions of a third embodiment of the present invention.

Fig. 10 is a block diagram illustrating the control construction of the third embodiment of the present invention.

25 Figs. 11A and 11B are typical views illustrating a main scan deviation detecting method and a skew feed detecting method in the third

embodiment of the present invention.

Fig. 12 is a flow chart illustrating the control procedure of effecting main scan deviation correction and skew feed correction in the third

5 embodiment of the present invention.

Fig. 13 is a typical view illustrating a method of correcting the skew feed of a sheet transported by a conventional sheet transporting apparatus.

10 DESCRIPTION OF THE PREFERRED EMBODIMENTS
(First Embodiment)

Description will first be made of a first embodiment of a sheet transporting apparatus which achieves the objects of the present invention.

15 Fig. 1 is a schematic view illustrating the construction of the essential portions of the sheet transporting apparatus according to the present embodiment. In Fig. 1, the same members as the members shown in Fig. 13 are given the same reference

20 numerals.

In Fig. 1, the sheet transporting apparatus according to the present embodiment has transporting rollers 13 and 14 frictionally contacting with a sheet to thereby transport the sheet in a

25 predetermined transport direction, and a sheet detecting line sensor 17, which is perpendicular to the transport direction of the sheet and disposed at

a distance equal from the center of a transport path
along which the sheet is normally transported to the
right and left in order to measure the deviation
amount and deviation direction in a direction

5   perpendicular to the sheet transport direction
(hereinafter referred to as the main scan direction),
and a skew feed direction and a skew feed amount N.
Also, this sheet detecting line sensor 17 is disposed
downstream of the transporting rollers 13 and 14 in

10 the transport path of the sheet.

Also, the transporting rollers 13 and 14 each
have a center of rotation on a straight line
extending in the main scan direction (cross
direction) on the transport path of the sheet, and

15 are disposed in opposed relationship with each other
with an interval of a distance "a" therebetween, and
are directly connected to pulse motors 11 and 12,
respectively, and are drive-controlled independently
of each other.

20 The detectable area "d" by the sheet detecting
line sensor 17 is wider than at least the widthwise
length of the transport path of the sheet.

Fig. 2 is a block diagram illustrating the
control construction of the sheet transporting

25 apparatus according to the present embodiment. In Fig.
2, a skew feed amount calculating portion 201
calculates the skew feed direction and skew feed

amount N of the sheet being transported relative to the normal transport posture thereof on the basis of detection information from the sheet detecting line sensor 17. A main scan deviation amount calculating

5   portion 203 calculates a main scan deviation direction which is a direction deviating from a normal transport position in the cross direction of the sheet, and a main scan deviation amount X which is a deviation amount in the main scan deviation

10   direction, on the basis of the detection information from the sheet detecting line sensor 17.

     A correction control portion 202 controls driving pulse numbers individually given to the pulse motors 11 and 12, and corrects the main scan

15   deviation amount and skew feed amount of the sheet during transport, on the basis of the signals of the skew feed direction and the skew feed amount N transmitted from the skew feed amount calculating portion 201, and the signals of the main scan

20   deviation direction and the main scan deviation amount X transmitted from the main scan deviation amount calculating portion 203.

     Each of the skew feed amount calculating portion 201, the correction control portion 202 and

25   the main scan deviation amount calculating portion 203 may be comprised, for example, of a controller provided with a CPU, a ROM, a RAM etc., and storing

therein a program for effecting various kinds of control in accordance with the procedure of a flow chart which will be described later.

Figs. 3A and 3B are typical views illustrating
5   a method of detecting the main scan deviation direction, the main scan direction amount X, the skew feed direction and the skew feed amount N (hereinafter referred to as the transported state) of the sheet in the sheet transporting apparatus
10   according to the present embodiment, and in these figures, the same portions are given the same reference numerals and need not be described.

For the calculation of the main scan deviation amount X, when first, with one side (the pulse motor
15   11 side) of the sheet detecting line sensor 17 as the reference, as shown in Fig. 3A, the position at which the sheet detecting line sensor 17 has first detected the sheet is defined as α, and the normal positions in the main scan direction which the sheet should
20   originally pass are defined as "b" and "c" ("b" is the position of the end portion of the sheet on the pulse motor 11 side, and "c" is the position of the end portion of the sheet on the pulse motor 12 side), the main scan deviation amount X can be obtained from
25        $X = c-\alpha$ (or $X = b-\alpha$).

Next, for the calculation of the skew feed amount N, when after the sheet portion has first been

detected by the sheet detecting line sensor 17, as shown in Fig. 3B, the position at which the detected position of the sheet by the sheet detecting line sensor 17 assumes a minimum value (or a maximum

5 value) is defined as β, the time until the position β is assumed is counted at a constant frequency "f" to thereby measure a detected skew feed count number C.

Next, a detected skew feed amount Nb detected by the sheet detecting line sensor 17 is calculated

10 from $Nb = C \times V/f$ by the use of transporting speed V of the sheet. Then, the skew feed amount N in the transporting roller portion actually used for the correction control portion 202 to control the pulse motors 11 and 12 is calculated from $N = Nb \times (\alpha-\beta)/a$

15 by the use of the detected skew feed amount Nb detected by the sheet detecting line sensor and the distance between the transporting rollers 13 and 14.

The correction control portion 202 then controls the driving pulses of the pulse motors 11

20 and 12 on the basis of the thus obtained transport state to thereby correct the main scan deviation amount and skew feed amount of the transported sheet.

A correction control method for the main scan deviation amount and the skew feed amount in the

25 sheet transporting apparatus according to the present embodiment will hereinafter be described with reference to a flow chart shown in Fig. 4.

In the case of Figs. 3A and 3B, the sheet is in a skew feed posture rotated leftwardly relative to its normal position and therefore, the corner portion of the sheet which is far from the reference position of the sheet detecting line sensor 17 is first detected and the value thereof becomes a maximum value, but in an opposite skew feed posture, the corner portion of the sheet which is near is first detected and therefore the value thereof becomes a minimum value.

In Fig. 4, the main scan deviation correction amount obtained on the basis of the main scan deviation amount X is represented by Xo, the main scan deviation allowable value determining the allowable range of the main scan deviation amount X is represented by Xm, and the skew feed allowable value determining the allowable range of the skew feed amount N is represented by Nm.

When at a step 1, the sheet detecting line sensor 17 detects the sheet, the main scan deviation amount calculating portion 203 calculates the main scan deviation direction and the main scan deviation amount X.

When at a step 2, the detected position of the sheet by the sheet detecting line sensor 17 has assumed a minimum value (or a maximum value), the skew feed amount calculating portion 201 calculates

the skew feed direction and the skew feed amount N.

At a step 3, the correction control portion 202 judges whether the main scan deviation amount X is within a range of $-Xm \leq X \leq Xm$, and when it is judged to be within this allowable range, at a step 8, the correction control portion 202 judges whether the skew feed amount N is within an allowable range of $-Nm \leq N \leq Nm$, and when it is judged to be within the allowable range processing is ended.

on the other hand, when at the step 3, the main scan deviation amount X is judged to be not within the allowable range of $-Xm \leq X \leq Xm$, at a step 4, the correction of the main scan deviation amount (hereinafter referred to as the main scan deviation correction) is effected for a predetermined period by the correction control portion 202.

Then, at a step 5, a total skew feed amount is calculated from the skew feed amount caused by the main scan deviation correction and the skew feed amount calculated by the skew feed amount calculating portion 201, and at a step 6, the correction of the total skew feed amount (hereinafter referred to as the skew feed correction) is effected by the correction control portion 202.

Subsequently, at a step 7, the correction control portion 202 judges whether the main scan deviation correction amount Xo is within an allowable

range of $X-Xm \leq Xo \leq X+Xm$, and when it is judged to be within the allowable range, processing is ended.

When at the step 7, the main scan deviation correction amount correction Xo is judged to be not within the allowable range of $X-Xm \leq Xo \leq X+Xm$, return is made to the step 4, where the main scan deviation correction is again effected for a predetermined period by the correction control portion 202, whereafter similar steps are executed.

When at a step 8, the skew feed amount N is judged to be not within the allowable range of $-Nm \leq N \leq Nm$, at a step 9, the skew feed correction is effected by the correction control portion 202 by an amount corresponding to the skew feed amount N calculated by the skew feed amount calculated portion 201, and processing is ended.

As described above, according to the present embodiment, the pulse motors 11 and 12 are drive-controlled in conformity with the transported state of the sheet calculated on the basis of the detection information of the transported sheet to thereby effect the widthwise deviation correction and the skew feed correction, whereby the sheet can be corrected into its normal transported state and be transported.

(Second Embodiment)

A second embodiment will now be described.

While in the above-described first embodiment, description has been made of the correction control in which the main scan deviation correction and the skew feed correction are repeated and effected little
5   by little on the basis of the deviation direction in the main scan direction, the deviation amount in the main scan direction, the skew feed direction and the skew feed amount calculated by detecting the sheet transported sheet by the sheet detecting line sensor
10 as the sheet detecting means downstream of the transporting rollers as the driving means for transporting the sheet, in the present embodiment, the sheet detecting line sensor 17 as the sheet detecting means is disposed upstream of the
15 transporting rollers as the sheet driving means with respect to the transport direction, and design is made so as to effect the main scan deviation correction and the skew feed correction by transporting rollers downstream of the sheet
20 detecting line sensor 17 with respect to the transport direction, i.e., transporting rollers discrete from the transporting rollers which have caused skew feed, on the basis of the deviation direction in the main scan direction, the deviation
25 amount in the main scan direction, the skew feed direction and the skew feed amount calculated by detecting the sheet.

Fig. 5 is a schematic view illustrating the construction of the essential portions of a sheet transporting apparatus according to the present embodiment, and in Fig. 5, the above-described

5   portions are given the same reference numerals and need not be described. The sheet detecting line sensor 17 in the present embodiment is disposed upstream of the transporting rollers 13 and 14 for effecting the main scan deviation correction and the

10   skew feed correction on the transport path of the sheet with respect to the transport direction, and effects the detection of the transported state of the sheet transported by transporting means, not shown.

Fig. 6 is a block diagram illustrating the

15   control construction of the sheet transporting apparatus according to the present embodiment.

In Fig. 6, the reference numeral 601 designates a skew feed amount calculating portion which calculates the skew feed direction and skew feed

20   amount N of the sheet on the basis of detection information from the sheet detecting line sensor 17. The reference numeral 603 denotes a main scan deviation amount calculating portion which calculates the main scan deviation direction and main scan

25   deviation amount X of the sheet on the basis of the detection information from the sheet detecting line sensor 17. A correction control portion 602 controls

driving pulse numbers given to the pulse motors 11 and 12 on the basis of the signals of the skew feed direction and the skew feed amount N transmitted from the skew feed amount calculating portion 601, and the

5   main scan deviation direction and the main scan deviation amount X transmitted from the main scan deviation amount calculating portion 603, and corrects the main scan deviation amount and skew feed amount of the transported sheet.

10   Each of the skew feed amount calculating portion 601, the correction control portion 602 and the main scan deviation amount calculating portion 603 may be comprised, for example, of a controller provided with a CPU, a ROM and a RAM, and may be

15   controlled in accordance with the procedure of a flow chart which will be described later.

Figs. 7A and 7B are typical views illustrating a method of detecting the transported state of the sheet in the sheet transporting apparatus according

20   to the present embodiment, and in these figures, the same members as the above-described members are given the same reference numerals and need not be described.

For the calculation of the main scan deviation amount X, first, when the position at which the sheet

25   has first been detected by the sheet detecting line sensor 17 is defined as α, and the normal widthwise positions which the sheet should originally passes at

the sheet detecting line sensor 17 are defined as "b" and "c" ("b" is the position of the end portion of the sheet on the pulse motor 11 side, and "c" is the position of the end portion of the sheet on the pulse

5 motor 12 side), X is calculated from

$$X = c-\alpha \text{(or } X = b-\alpha\text{)}.$$

For the calculation of the skew feed amount N, a position β at which the detected position of the sheet by the sheet detecting line sensor 17 assumes a

10 minimum value (or a maximum value) and the time until the sheet becomes undetected by the sheet detecting line sensor 17 are counted at a constant frequency "f" to thereby measure a detected skew feed count number C. Also, the position at which the sheet has

15 been detected lastly by the sheet detecting line sensor 17 is defined as γ.

Next, the detected skew feed amount Nb in the sheet detecting line sensor 17 itself is calculated from $Nb = C \times V/f$ by the use of the transporting

20 speed of the sheet. The skew feed amount N in the transporting roller portion actually used for the correction control portion 602 to control the pulse motors 11 and 12 is calculated from $N = Nb \times (\gamma-\beta)/a$ by the use of the detected skew feed amount Nb

25 detected by the sheet detecting line sensor and the distance "a" between the transporting rollers.

The correction control portion 602 controls

driving pulse numbers given to the pulse motors 11 and 12 on the basis of the signals of the thus obtained skew feed direction and skew feed amount N, and the main scan deviation direction and the main
5 scan deviation amount X, and corrects the main scan deviation amount and skew feed amount of the transported sheet.

A method of correcting the main scan deviation amount and skew feed amount in the sheet transporting
10 apparatus according to the present embodiment will hereinafter be described with reference to a flow chart shown in Fig. 8.

Fig. 8 is a flow chart illustrating the procedure of correcting the main scan deviation
15 amount and skew feed amount in the sheet transporting apparatus according to the present embodiment.

A main scan deviation allowable value determining the allowable range of the main scan deviation amount X is represented by Xm, and a skew
20 feed allowable value determining the allowable range of the skew feed amount N is represented by Nm.

At a step 11, when the sheet detecting line sensor 17 detects the sheet, the main scan deviation amount calculating portion 603 calculates the main
25 scan deviation direction and the main scan deviation amount X.

At a step 12, the correction control portion

602 judges whether the main scan deviation amount X is within an allowable range of $-Xm \leq X \leq Xm$, and when it is judged to be within the allowable range, the main scan deviation correction is not effected,

5 but the sheet is intactly transported.

Next, when at a step 14, the detected position of the sheet by the sheet detecting line sensor 17 assumes a minimum value (or a maximum value) and thereafter the sheet becomes undetected by the sheet

10 detecting line sensor 17, the skew feed amount calculating portion 601 calculates the skew feed direction and the skew feed amount N. Subsequently, at a step 15, the correction control portion 602 judges whether the skew feed amount N is within an

15 allowable range of $-Nm \leq N \leq Nm$, and when it is judged to be within the allowable range, processing is ended.

On the other hand, when at the step 12, the main scan deviation amount X is judged to be not

20 within the allowable range of $-Xm \leq X \leq Xm$, at a step 13, the main scan deviation correction is effected by the correction control portion 602 by an amount corresponding to the main scan deviation amount X calculated by the main scan deviation amount

25 calculating portion 603, whereafter the sheet is transported.

When at the step 15, the skew feed amount N is

judged to be not within the range $-Nm \leq N \leq Nm$, at a step 16, the skew feed correction is effected by the correction control portion 602 by an amount corresponding to the skew feed amount N calculated by

5   the skew feed amount calculating portion 601, and processing is ended.

As described above, according to the present embodiment, the sheet detecting line sensor as the detecting means is disposed upstream of the

10 transporting rollers 13 and 14 with respect to the transport direction, and the pulse motors 11 and 12 are drive-controlled in conformity with the transported plate obtained on the basis of the detection information of the transported sheet to

15 thereby effect the widthwise deviation correction, whereafter the skew feed correction is effected, whereby the sheet can be transported with the main scan deviation and skew feed thereof corrected.
(Third Embodiment)

20   A third embodiment will now be described. While in the above-described first embodiment, description has been made of the correction control in which the main scan deviation correction and the skew feed correction are repeated and effected little by little

25 on the basis of the deviation direction of the main scan direction, the deviation amount of the main scan direction, the skew feed direction and the skew feed

amount calculated by detecting the transported sheet by the sheet detecting line sensor as the sheet detecting means downstream of the transporting rollers as the driving means for transporting the

5 sheet, the present embodiment is designed such that the main scan deviation correction is effected on the basis of the deviation direction of the main scan direction, the deviation amount of the main scan direction, the skew feed direction and the skew feed

10 amount calculated by detecting the transported sheet, whereafter a total skew feed amount is calculated from the aforementioned calculated skew feed amount and the skew feed amount caused by the main scan deviation correction to thereby effect the skew feed

15 correction.

In the present embodiment, the main scan deviation correction is effected on the basis of the transported state obtained by detecting the transported sheet, whereafter the total skew feed

20 amount is calculated from the aforementioned calculated skew feed amount and the skew feed amount caused by the main scan deviation correction to thereby effect the skew feed correction.

Fig. 9 illustrates the construction of a sheet

25 transporting apparatus according to the present embodiment, and in Fig. 9, the same members as the above-described members are give the same reference

numerals, and need not be described. Fig. 10 is a block diagram illustrating the control construction of the sheet transporting apparatus according to the present embodiment.

5   In Fig. 10, the reference numeral 17 designates a sheet detecting line sensor which effects the detection of the transported state of the sheet. The reference numeral 1001 denotes a skew feed amount calculating portion which calculates the skew feed

10 direction and skew feed amount N of the sheet on the basis of detection information from the sheet detecting line sensor 17. The reference numeral 1003 designates a main scan deviation amount calculating portion which calculates the main scan deviation

15 direction and main scan deviation amount X of the sheet on the basis of the detection information from the sheet detecting line sensor 17.

The reference numeral 1004 denotes a total skew feed amount calculating portion which calculates the

20 skew feed direction and skew feed amount M of the sheet after the main scan deviation correction based on the main scan deviation direction and the main scan deviation amount X transmitted from the main scan deviation amount calculating portion 1003 has

25 been effected, and calculates a total skew feed direction as an overall skew feed direction and a total skew feed amount L as an overall skew feed

amount from the skew feed direction and the skew feed amount N transmitted from the skew feed amount calculating portion 1001 and the skew feed direction and the skew feed amount M caused by the main scan

5   deviation correction.

A correction control portion 1002 increases or decreases driving pulse numbers given to the right and left pulse motors 11 and 12, on the basis of the total skew feed direction and the total skew feed

10   amount L transmitted from the total skew feed amount calculating portion 1004, and the main scan deviation direction and the main scan deviation amount X transmitted from the main scan deviation amount calculating portion 1003, and corrects the main scan

15   deviation amount and skew feed amount of the transported sheet.

While in the present embodiment, the total skew feed amount calculating portion 1004 is of a construction discrete from the correction control

20   portion 1002, this is not restrictive, but for example, the total skew feed amount calculating portion 1004 may be of a construction included in the correction control portion 1002.

Each of the skew feed amount calculating

25   portion 1001, the correction control portion 1002, the main scan deviation amount calculating portion 1003 and the total skew feed amount calculating

portion 1004 may be comprised, for example, of a
controller provided with a CPU, a ROM, a RAM, etc.,
and may be of a construction which controls in
accordance with the procedure of a flow chart which
5 will be described later.

Figs. 11A and 11B are typical views
illustrating a method of detecting a sheet position
in the sheet transporting apparatus shown in Fig. 9,
and in these figures, the same members as those in
10 Fig. 9 are given the same reference numerals.

For the calculation of the main scan deviation
amount X, first, when the position at which the sheet
has been first detected by the sheet detecting line
sensor 17 is defined as α, and the widthwise
15 positions which the sheet should originally pass are
defined as "b" and "c" ("b" is the pulse motor 11
side, and "c" is the pulse motor 12 side), X is
calculated from $X = c-\alpha$ (or $X = b-\alpha$).

Next, for the calculation of the skew feed
20 amount N, the time from after the sheet position has
been first detected by the sheet detecting line
sensor 17 until the detected position of the sheet by
the sheet detecting line sensor 17 assumes a minimum
value (or a maximum value) is counted at a constant
25 frequency f to thereby measure a skew feed count
number C. Next the detected skew feed amount Nb in
the sheet detecting line sensor 17 itself is

calculated from $Nb = C \times V/f$ by the use of the transporting speed V of the sheet. The skew feed amount N in the transporting roller portion actually used for the correction control portion 1002 to

5 control the pulse motors 11 and 12 is calculated from $N = Nb \times b/a$ by the use of the detected skew feed amount Nb detected by the sheet detecting line sensor 17, the distance "a" between the transporting rollers and the distance "b" from the sheet detecting line

10 sensor.

A method of correcting the main scan deviation amount and the skew feed amount in the sheet transporting apparatus according to the present embodiment will hereinafter be described with

15 reference to a flow chart shown in Fig. 12.

Fig. 12 is a flow chart illustrating the procedure of the method of correcting the main scan deviation amount and the skew feed amount in the sheet transporting apparatus according to the present

20 embodiment.

In Fig. 12, a main scan deviation allowable value determining the allowable range of the main scan deviation amount X is represented by Xm, and a skew feed allowable value determining the allowable

25 range of the skew feed amount N is represented by Nm.

When at a step 21, the sheet detecting line sensor 17 detects the sheet, the main deviation

amount calculating portion 1003 calculates the main scan deviation direction and the main scan deviation amount X.

When at a step 22, the detected position of the sheet by the sheet detecting line sensor 17 assumes a minimum value (or a maximum value), the skew feed amount calculating portion 1001 calculates the skew feed direction and the skew feed amount N.

At a step 23, the correction control portion 1002 judges whether the main scan deviation amount X is within an allowable range of $-Xm \leq X \leq Xm$, and when it is judged to be within the allowable range, at a step 29, the correction control portion 1002 judges whether the skew feed amount N is within an allowable range of $-Nm \leq N \leq Nm$, and when it is judged to be within the allowable range, processing is ended.

When at the step 23, the main scan deviation amount X is judged to be not within the allowable range of $-Xm \leq X \leq Xm$, at a step 24, main scan deviation correction is effected by the correction control portion 1002.

Next, at a step 25, the skew feed direction and the skew feed amount M caused by the main scan deviation correction are calculated by the total skew feed amount calculating portion 1004, and subsequently at a step 26, the total skew feed

direction and the total skew feed amount L are calculated by the total skew feed amount calculating portion 1004 with the skew feed direction and the skew feed amount N obtained from the skew feed amount

5   calculating portion 1001 being taken into account.

Next, at a step 27, the correction control portion 1002 judges whether the total skew feed amount L is within an allowable range of $-Nm \leq L \leq Nm$, and when it is judged to be within the allowable

10 range, processing is ended.

When at the step 27, the total skew feed amount L is judged to be not within the allowable range of $-Nm \leq L \leq Nm$, at a step 28, skew feed correction is effected by the correction control portion 1002 by an

15 amount corresponding to the total skew feed amount L calculated by the total skew feed amount calculating portion 1004.

When at a step 29, the skew feed amount N is judged to be not within an allowable range of $-Nm \leq N$

20 $\leq Nm$, at a step 30, skew feed correction is effected by the correction control portion 1002 by an amount corresponding to the skew feed amount N calculated by the skew feed amount calculating portion 1001, and processing is ended.

25 Thus, main scan deviation correction is effected on the basis of the widthwise deviation direction, the widthwise deviation amount X, the skew

feed direction and the skew feed amount N calculated on the basis of the detection of the transported sheet, whereafter the pulse motors 11 and 12 are drive-controlled in conformity with the total skew

5   feed amount L from the above-calculated skew feed amount N and the skew feed amount M caused by the main scan deviation correction to thereby effect the correction of the main scan deviation amount and the correction of the skew feed amount at a time, whereby

10   the sheet can be transported in a normal transported state.

It is also possible to supply a storage medium having recorded therein a program code of software for realizing the operation of the sheet transporting

15   apparatus according to each of the above-described embodiment to a system or an apparatus having a computer or the like, and read out and execute the program code stored in this storage medium by the computer (or the CPU or MPU) of the system or the

20   apparatus. In this case, the above-described system is not restricted to one having a single apparatus, but may be one having a plurality of apparatuses.

The sheet transporting apparatus according to each of the above-described embodiments can also be

25   used as sheet transporting means in an image reading apparatus such as a scanner, or an image forming apparatus such as a printer or a facsimile.